(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 919 178 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.06.1999 Bulletin 1999/22

(51) Int. Cl.[6]: **A47L 15/42**

(21) Application number: **98122315.9**

(22) Date of filing: **25.11.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **27.11.1997 IT TO971039**

(71) Applicant: **T & P S.p.A.**
21049 Tradate (Varese) (IT)

(72) Inventors:
- **Carli, Carlo**
  21100 Varese (IT)
- **Cazzini, Emilio**
  21050 Lonate Ceppino (VA) (IT)

(74) Representative:
Dini, Roberto, Dr. Ing.
Via Castagnole, 59
10060 None (Torino) (IT)

(54) Device for reducing water hardness (softener) having a resins exhaustion sensor, and washing machine having said device

(57) A device for reducing the water hardness (softener), suitable for the use in a household washing machine, in particular a dishwasher, comprising a container within which ionic exchange resins are housed, which reduce the hardness degree of the water licking on them, and means for regenerating the softening efficiency of said resins, characterized in that inside said container (1) sensor means (8-8',9-9'; 14,15,18; 20-22; 27-29) are provided for checking the status of said resins (3) and, depending upon the physical status of said resins, detecting the degree of exhaustion of said resins (3).

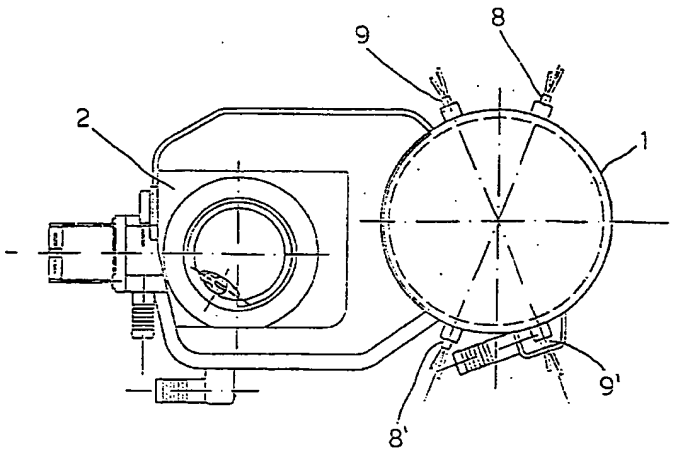

FIG. 2

EP 0 919 178 A2

Description

[0001] The present invention relates to a device for reducing water hardness (softener), suitable for the use in a household washing machine, in particularly a dishwasher, and to a control method to check the exhaustion degree of the water hardness reducing means.

[0002] It is well-known that household washing machines operating with water, more particularly dishwashers, are equipped with a device for decalcifying the washing and rinsing water, i.e. for reducing the water hardness degree, so as to avoid likely calcareous scale deposit. Such a device is also known as a water softener.

[0003] Calcareous scale deposits are caused by an extremely high quantity of calcium ions (Ca++) and magnesium ions (Mg++) contained in the washing water.

[0004] Such a decalcifier exchanges both the calcium ions (Ca++) and magnesium ions (Mg++) contained in the water with sodium ions (Na+) contained in appropriate resins placed in the decalcifier.

[0005] Resins or another similar substance, herein called resins for simplicity's sake, become exhausted after a certain usage time, i.e. their ions Na+ to be exchanged with Ca++ and Mg++ contained in the water are consumed; as a result, water will still flow through said resins but substantially maintain its become exhausted.

[0006] This drawback is prevented through a resins regeneration phase, which is obtained introducing a water-salt solution (NaCl) with the aim of regenerating the resins. This phase is generally executed for each wash cycle, for which a considerable quantity of salt has to be used, often introduced by the user; moreover, a higher water consumption is also determined.

[0007] It is well-known that in view of reducing salt and water wastage some washing machines are equipped with water hardness sensors, through which resins regeneration will be activated only when the water hardness is not sufficiently reduced due to the resins exhaustion.

[0008] Said sensors are used to measure the water resistivity and, from the results obtained through an electronic system, the resins regeneration will either be activated or not.

[0009] This system requires that electrodes have to be dipped in the water and electrically supplied.

[0010] Although a low voltage is applied to the sensors, there will always be a danger, because these sensors are in direct contact with water. Moreover, even if the water hardness is reduced, nothing hinders that a light calcareous layer may deposit on the sensors before the resins regeneration is activated, thus altering the water hardness detection due to the additional calcareous resistivity.

[0011] Such systems detect the water hardness directly, whereas the resin status is detected only indirectly; as a result, the resins regeneration will be activated also in those instances where it is not yet required.

[0012] The aim of the present invention is that of solving the above drawbacks and provide in particular a device for reducing water hardness (softener), which is suitable for the use in a household washing machine, in particular a dishwasher, wherein the detection of the exhaustion of the reducing means is realized in a simple, safe, cheaper and direct manner.

[0013] Within this frame, it is the object of the present invention a device for reducing the water hardness (softener), which is suitable for the use in a household washing machine, in particular a dishwasher, and a control method to check the exhaustion degree of the water hardness reducing means, and a washing machine using such a device, all comprising the features of the annexed claims which form an integral part of the present description.

[0014] Further aims and advantages of the present invention will become apparent from the following detailed description and the annexed drawings, which are supplied by way of non limiting example, wherein:

- Figure 1 shows schematically a device for reducing the water hardness according to the prior art;
- Figure 2 shows a plan view of a device for reducing the water hardness having a sensor of a first type, to detect the exhaustion of the resins used to reduce the water hardness according to the present invention;
- Figure 3 shows a section view of a device for reducing the water hardness having a sensor of a first type, to detect the exhaustion of the resins used to reduce the water hardness according to the present invention;
- Figure 4 shows a partial section view of a first variant embodiment of the detecting system of the exhaustion of the resins used to reduce the water hardness according to the present invention;
- Figure 5 shows a partial section view of a second variant embodiment of the detecting system of the exhaustion of the resins used to reduce the water hardness according to the present invention;
- Figure 6 shows an exploded view of the second variant embodiment of the detecting system of the exhaustion of the resins used to reduce the water hardness according to the present invention;
- Figure 7 shows a partial section view of a third variant embodiment of the detecting system of the exhaustion of the resins used to reduce water hardness according to the present invention;
- Figure 8 shows an exploded view of the third variant embodiment of the detecting system of the exhaustion of the resins used to reduce the water hardness according to the present invention.

[0015] It should be noticed that the present invention

is based on the acknowledgment that the resins used to reduce water hardness tend to change their volume as they become exhausted.

[0016] In other words, their physical status, i.e. either their volume or the force they are able to exert, if pressed in an environment having a fixed volume, will change according to the variation of their exhaustion degree.

[0017] In Figure 1, where a water softener is schematically represented, i.e. a device for reducing the water hardness according to the known state of the art, number 1 indicates the resin container, number 2 indicates a salt container for the regeneration of the resins; the two containers are mechanically and hydraulically connected to each other and the water softener is manufactured in two parts, which are welded together through a hot-blade process, after having assembled the various components inside it; number 3 indicates the water softening resins; number 4 indicates an upper filter, number 5 indicates a lower filter, number 6 indicates the weld spot of both parts forming the water softener and number 7 various water pipelines.

[0018] Figures 2 and 3 show a plan view and a section view of a device for reducing the water hardness manufactured with a first type of sensor to detect the exhaustion of the resins used to reduce water hardness according to the present invention; in said figures 2 and 3 the same reference numbers as per Figure 1 are used to indicate the common elements.

[0019] Numbers 8 and 8' indicate a couple of optical detectors arranged outside the body of the resins container 1, diametrically opposite to each other.

[0020] Numbers 9 and 9' indicate a second couple of optical detectors arranged outside the body of the resins container 1, diametrically opposite to each other.

[0021] The two diameters resulting from the two couples of sensors 8-8' and 9-9' have to be selected to have the largest area as possible covered by the sensors, compatibly with the overall dimensions of the decalcifier device.

[0022] One sensor of said couples 8-8' and 9-9' is the light signal transmitter and the other sensor is the receiver.

[0023] Said sensors 8-8', 9-9' are arranged outside and in contact with the resins container 1; their position and alignment for the correct operation is ensured by a structure 10, which is fitted and fastened outside the resin container 1 and carries the seats for said sensors.

[0024] The line A indicates a first level reached by the resins in the container 1; the letter B indicates a second level reached by the resins in the container 1.

[0025] Said first level A relates to the operating situation of the resins in their original status, i.e. before being used for the water softening, whereas said second level B represents the position of the resins after reaching a certain exhaustion degree.

[0026] In fact, as resins become exhausted, they undergo a volume reduction by 4-8% according to what type of resins is used.

[0027] The couples of optical detectors 8-8' and 9-9' have the function of checking the variation of the resins height inside the container 1.

[0028] When the height reaches a level where it can be determined that for example 70% of exhaustion has been reached, then the resins regeneration will be activated by said optical detectors conveniently arranged for such a height.

[0029] Thus, the resins regeneration will only take place when required to avoid water and salt wastage.

[0030] Additionally, this solution will never let resins to reach a complete exhaustion, with the consequent risk of using too hard water.

[0031] In order to obtain a good operation of the optical detectors 8-8' and 9-9', the material used for the resin container may be a clear one; otherwise the resin container may be manufactured with clear inserts, just in the area where said optical detectors are located.

[0032] Since the resins level is not constant all along the perimeter, at least two couples of optical detectors are required, to carry out at least two detections and determine a level mean for the resins both in their natural status and exhaustion stage.

[0033] In Figure 4, where a partial section view of a first variant embodiment of the detecting system of the exhaustion of the resins for reducing the water indicates a resins container and number 12 a space formed outside the container 11.

[0034] Said space 12 has an open lower base, in correspondence with the joint line of the two parts of the container 11; a vertical wall of said space 12, indicated with number 13, realizes the outside wall of the container 11 and has slits interconnecting the container 11 with the space 12.

[0035] Number 14 indicates a pressure sensor, for example of the piezoelectric type, arranged on the upper wall of the space 12 during the moulding of the container 11.

[0036] Number 15 indicates a transducer being connected with the pressure sensor 14; number 16 indicates connections, which may be wires or Faston terminals; number 17 indicates a filter for the water entering the washing machine.

[0037] The space 12 is completely filled with a certain amount of sample resins, indicated with number 18, being of the same type of the resins contained in the container 11.

[0038] Resins 18 are introduced in the space 12 through its open part and maintained in position inside it through a portion of the filter 17, when the latter is welded to the above two parts forming the container.

[0039] Welding is executed according to a so-called hot-blade welding process, i.e. both parts to be welded are melted together with a consequent height reduction of the vertical walls of the parts involved.

[0040] As a result, resins 18 are compressed and will fill up all the available room in the space 12, so exerting

also a certain pressure on the sensor 14.

[0041] When the water to be softened flows through the resins in the container 11, it will also reach said resins 18 contained in the space 12 through the holes of the filter portion closing the space 12.

[0042] The water from the filter 17, flowing through the resins 18, will then flow back to the container 11 through the slits being defined on the wall 13 of the space 12. Said slits are so dimensioned to let water to flow through, but will not let any resins go through.

[0043] As the resins inside the container 11 become exhausted, their volume will decrease as previously said; the same happens for the resins contained in the space 12, as they also become exhausted and their volume will decrease accordingly; this shrinking determines a change in the pressure exerted on the inner walls of the space 12 and consequently on the pressure sensor 14.

[0044] Said pressure will decrease as resin exhaustion goes on, while the pressure sensor 14 decreases its electric polarization due to its own physical properties.

[0045] Upon reaching a certain threshold, for example 70%, referred to the pressure reached by the resins becoming exhausted, the regeneration is activated.

[0046] Regeneration is activated under the control of an electronic control system, not shown in the figures as already generally known, which detects the signal transmitted by the pressure sensor 14 through the transducer 15.

[0047] Since said pressure sensor 14 is in contact with water, its complete electrical insulation to water and resins is required to ensure correct operation.

[0048] It is obvious that many changes are possible for the man skilled in the art to the device for reducing the water hardness (softener) suitable for the use in a washing machine, in particular a dishwasher, comprising means for detecting the resins exhaustion being contained within said device described by way of example, without departing from the novelty spirit of the inventive idea.

[0049] A possible variant embodiment can be obtained using for example an interchangeable sensor, as represented in Figures 5 and 6, in order to solve possible operating irregularities.

[0050] With reference to Figures 5 and 6, number 11' indicates a container for the resins used to reduce the water hardness, while number 12' indicates a space defined on a side of the container 11'.

[0051] Number 17' indicates a lower filter of the container 11'; number 13' indicates a wall of the space 12', which is a portion of the external wall of the container 11', being provided with some slits interconnecting the container 11' with the space 12'. As it can be seen, the space 12' has both ends open.

[0052] The lower end is closed by an extension of the filter 17', obtained as in the Number 19 indicates a cage whose shape and dimensions allow for its insertion inside the recess 12', as shown in Figure 5.

[0053] Number 20 indicates a certain amount of sample resins in their natural granular status, i.e. similar to the resins housed in the container 11'.

[0054] Number 21 indicates a pressure sensor with its relevant transducer 22 and electric wire or alternatively Faston terminal connections.

[0055] Said cage 19 has an open side allowing a forced insertion of the pressure sensor 21 in a pre-existing hole on the upper side of the cage 19, also allowing to fill the cage with the resins 20.

[0056] Said open side is then closed with a lid snap-fitted to the cage by means of small teeth, or welded in a known manner, for example by a hot-blade welding. The amount of resins filled in the cage will cause their compression when closing the lid, so that they exert a certain pressure on the sensor 21.

[0057] The cage walls, save for the wall whereon the pressure sensor is located, have slits for allowing the passage of water, but hinders the passage of the resins.

[0058] Said cage 19 fitted with the pressure sensor and filled with resins is inserted in the space 12' formed on the body of the container 11'.

[0059] The cage is kept inside the space 12' by a closure plug 23, which is screwed on the body of the space 12'.

[0060] The hydraulic sealing is obtained by interposition of a gasket 24 in rubber or similar material, which is inserted in a seat 25 formed on the body of the space 12', between the plug 23 and the body of the space 12'.

[0061] The operation occurs as previously described for the solution using a non-interchangeable pressure sensor.

[0062] According to a variant embodiment of the solution described above, a small block of resins compressed to a sodic form is used instead of granular resins, i.e. differing from the resins used in the container 11'.

[0063] A further variant embodiment in order to make the sensor interchangeable is represented in Figures 7 and 8, where the space for containing the pressure sensor with its respective resins, is perpendicular to the body of the container

[0064] Also this variant embodiment is provided with a cage 26 containing a pressure sensor 27 and relevant a transducer 28, along with its electric connections and resins 29.

[0065] In this case, the pressure sensor 27 is overmoulded on a side of the cage 26, namely on its upper side, so that the connections come out perpendicularly to a vertical side of the cage 26.

[0066] Said cage 26 has an open side to introduce the resins 29, which is then closed with a small lid being snap-fitted or welded by known processes, such as for example a hot- blade welding. Also in this case, the resins are compressed within the cage 26, in order to exert a certain pressure on the sensor 27.

[0067] Said cage 26 has slits on at least two walls,

allowing the water to flow through, but hindering the passage of the resins 29.

[0068] Number 30 indicates a space formed on the external wall of the container 11', for housing the cage 26.

[0069] Said recess 30 has slits on its bottom wall 34 and its lower wall 35, for allowing the water to flow from the bottom of the container 11' to the space 30 and inside the cage 26. Slits are also provided on the external wall of the container 11', as in the previous solutions.

[0070] The cage 26, complete with the sensor 27 and the resins 29, is housed in the space 30 and held in position by means of screws.

[0071] The hydraulic sealing is obtained by means of a gasket 31 inserted in a throat 32 formed on the edge of the recess 30, whereon a flange 33 formed on the cage 26 will rest.

[0072] Also this solution can use a small block of resins compressed to a sodic form instead of granular resins, i.e. differing from the ones used in the container 11'.

[0073] The variant embodiments as represented in Figures 5-6 and 7-8 are practically similar and can be used according to the water softener position on the washing machine, in order to ease the replacement of the sensor unit in case of malfunctioning.

[0074] As it results from the above description, the detecting system of the resins exhaustion in a washing machine is simple, has overall small dimensions and is easy to manufacture.

[0075] Moreover, the device has a high operating reliability, since the resins exhaustion is detected through a direct monitoring and does not require any water hardness control, which would only give indirect indication of the exhaustion degree of the resins themselves.

[0076] Additionally, the container where resins are housed also has a recess containing both the amount of sample resins and the exhaustion sensor, so that a further operational performance of the device is ensured. In fact, during operation, both the decalcifying resins and the sample resins are exposed to the same water temperature and pressure conditions, so that the resins exhaustion signal resulting from the sample resins gets closer to reality. Moreover, easy replacement of a likely faulty sensor improves the performance of the softening device.

[0077] In view of an advantageous implementation of the present invention, the system may also be applied to detect and indicate if salt is lacking in the container 2.

[0078] A typical float system according to the present state of the art is reliable enough to switch-off a signalling light after salt topping-up in the relevant container by the user; on the contrary, such a float system is often rather rough in signaling a lack of salt.

[0079] Therefore, this variant embodiment is based on the idea of exploiting the volume increase and/or decrease of the softening resins, which to a certain extent is also bound to a good operation of the brine used for resins regeneration.

[0080] In fact if the sensor, after having activated the resins regeneration due to the fact that they have reached a set exhaustion degree, detects at the end of such a regeneration that the resins volume has not gone back to its initial values (as detected by the sensor either optically or because the pressure exerted by the resins on the pressure sensor has a lower value than the brine has no longer enough salt concentration to ensure a correct regeneration.

[0081] As a result, the device controlling the sensor, i.e. an electronic control system as previously mentioned, will activate a light to warn the user that salt should be added to the container. Thus, the signal for salt topping-up occurs in a simple and reliable manner.

[0082] With reference to the embodiments of Figures 5 and 8, relating to the use of a pressure sensor, the possibility is mentioned of using, as sample resins (18,19,29), resins being already in the exhausted for (calcic form). in other words, in this case the sample resins will increase their volume only during the regeneration processes, so reducing the restraints of the manufacturing process being tied to the necessity to copress the sample resins (18,20,29) into the respective spaces, if they would be used in the active form. In this case, the detection of the resins exhaustion is signalled by an increase of the pressure of the sample resins on the pressure sensor, instead of a decrease of said pressure.

[0083] It is obvious, anyway, that without prejudice to the principle of the present invention, many changes are possible to the construction features of the device for reducing the water hardness (softener) suitable for the use in a washing machine, in particular a dishwasher, comprising a detecting system of the exhaustion of the resins to reduce the water hardness as described by way of example, without departing from the novelty spirit of the innovative idea, and it is also clear that in the practical actuation of the invention the components may differ in form and size from the ones described and be replaced with technical equivalent elements.

Claims

1. A device for reducing the water hardness (softener), suitable for the use in a household washing machine, in particular a dishwasher, comprising a container within which ionic exchange resins are housed, which reduce the hardness degree of the water licking on them, and means for regenerating the softening efficiency of said resins, characterized in that inside said container (1) sensor means (8-8',9-9'; 14,15,18; 20-22; 27-29) are provided for checking the status of said resins (3) and, depending upon the physical status of said resins, detecting the degree of exhaustion of said resins (3).

2. A device according to claim 1, characterized in that said sensor means (8-8',9-9'; 14,15,18; 20-22; 27-

29) detect a change in the physical status of said resins (3) through their volume variation.

3. A device according to claim 1, characterized in that said sensor means (14,15,18; 20-22; 27-29) detect a change in the physical status of said resins (3) through a change of the pressure exerted by a sample amount (18;20;29) of said resins (3) on a portion of said container (1).

4. A device according to claim 1, characterized in that said sensor means (8-8',9-9'; 14,15,18; 20-22; 27-29) are associated with a container (1) containing said resins (3) and/or are an integral part of the same.

5. A device according to claim 4, characterized in that said sensor means comprise optical sensors (8-8',9-9'), said optical sensors being in particular arranged in couples.

6. A device according to claim 4, characterized in that said sensor means (8-8',9-9';14,15,18;20-22;27-29) comprise a pressure sensor (14;21;27) and its relevant transducer (15; 22; 28).

7. A device according to claim 6, characterized in that said pressure sensor (14;21;27) detects the pressure exerted by a sample amount (18;20;29) of resins (3).

8. A device according to claim 7, characterized in that a space (12; 12'; 30) containing said sample amount (18; 20; 29) of resins (3) is provided, said recess (12;12';30) being hydraulically connected with said container (1), 34,35) defining said recess (12; 12'; 30).

9. A device according to claim 8, characterized in that said sample amount (18) of resins (3) is contained directly within said space (12).

10. A device according to claim 8, characterized in that said sample amount (18) of resins (20,29) is contained in a cage (19;26) arranged inside said space (12'; 30), said cage (19;26) having slits for the water passage and said space (12';30) forming a seat for said cage.

11. A device according to claim 9, characterized in that said sensor means (14,15,18) are associated with said space (12).

12. A device according to claim 10, characterized in that said sensor means (20-22; 27-29) are associated with said cage (19;26).

13. A device according to claim 9 or 10, characterized in that said amount of sample resins (20;29) is compressed within said cage (19;26) or said space (12).

14. A device according to claim 9, characterized in that one of the walls (17; 17') defining said space (12;12') is realized by an extension of a filter (17; 17') for constraining said resins (3) within said container (11; 11').

15. A device according to claim 9, characterized in that one of the walls (13; 13'; 34) defining said space (12; 12'; 30) is realized by at least a portion of an external surface of said container (11;11').

16. A device according to claim 15, characterized in that said space (12';30) is open on its front or on its top for the insertion of said cage (19;26).

17. A device according to claim 10, characterized in that fastening means are provided (23;33) to hold said cage (19;26) within said space (12';30), said means comprising in particular a closure plug (23) for said space (12';30) and/or a flange (33) for said cage (26).

18. A device according to claim 17, characterized in that hydraulic sealing means are provided between said space (12';30) and said fastening means (23;33), said sealing means comprising in particular a gasket (24;31) inserted in a throat (25;32) formed on the external edge of said space (12';30).

19. A device according to at least one of the previous claims, characterized in that said pressure sensor (14,21,27) is a piezoelectric type sensor.

20. A device according to at least one of the previous claims, characterized in that the resins of said sample amount (18,20,29) are of a different type and/or status with respect to the resins contained in said container (1).

21. A washing machine using a device for reducing the water hardness according to one or more of the previous claims, wherein signaling means are provided to indicate a lack of salt as required for correct operation of said device (1) for water softening, said signaling means being upon necessity activated in function of a detection performed by said sensor means (8-8',9-9'; 14,15,18; 20-22; 27-29) of the exhaustion degree of the resins (3).

22. A control method of the exhaustion degree of the resins used for water softening (3) in a household washing machine, in particular a dishwasher, characterized in that the detection is provided, though sensor means (8-8',9-9'), of the variation in the physical status of the resins (3), in the form of a

change of the volume of the resins (3), said change constituting an indication of the exhaustion degree of the softening power of said resins (3).

23. A control method of the exhaustion degree of the resins (3) used for the water softening in a household washing machine, in particular a dishwasher, characterized in that-the detection is provided, through a sensor (14;21;27), of a variation in the physical status of the resins (3) in the form of a change of the pressure exerted by said resins on said pressure sensor (14;21;27), said change constituting an indication of the exhaustion degree of the softening power of said resins (3).

24. A control method according to claim 22, characterized in that the change in the volume of the resins (3) is detected directly by optical sensor means (8-8',9-9').

25. A control method according to claim 22 or 23, characterized in that the resins physical status (3) is controlled after each regeneration step.

26. A control method according to claim 22 or 23, characterized in that if the status of the resins after a regeneration step does not reached a preset threshold, signalling means are activated for salt addition to a relevant recess (2), which is part of a device for reducing water hardness being provided in said dishwashing machine.

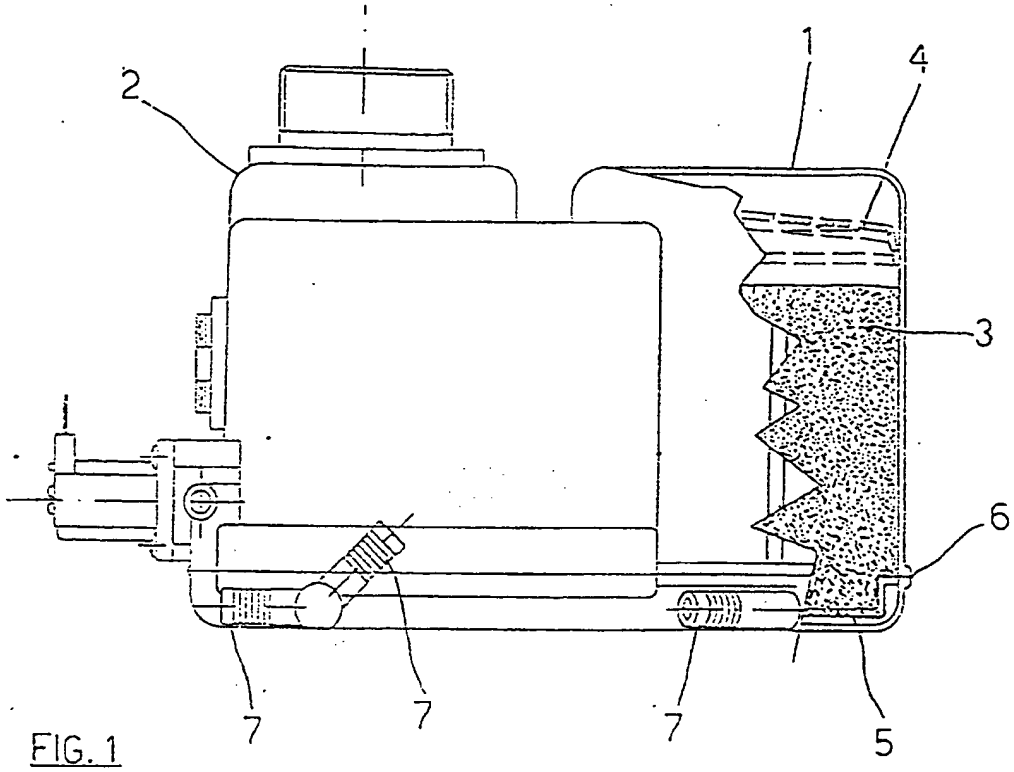

FIG. 1

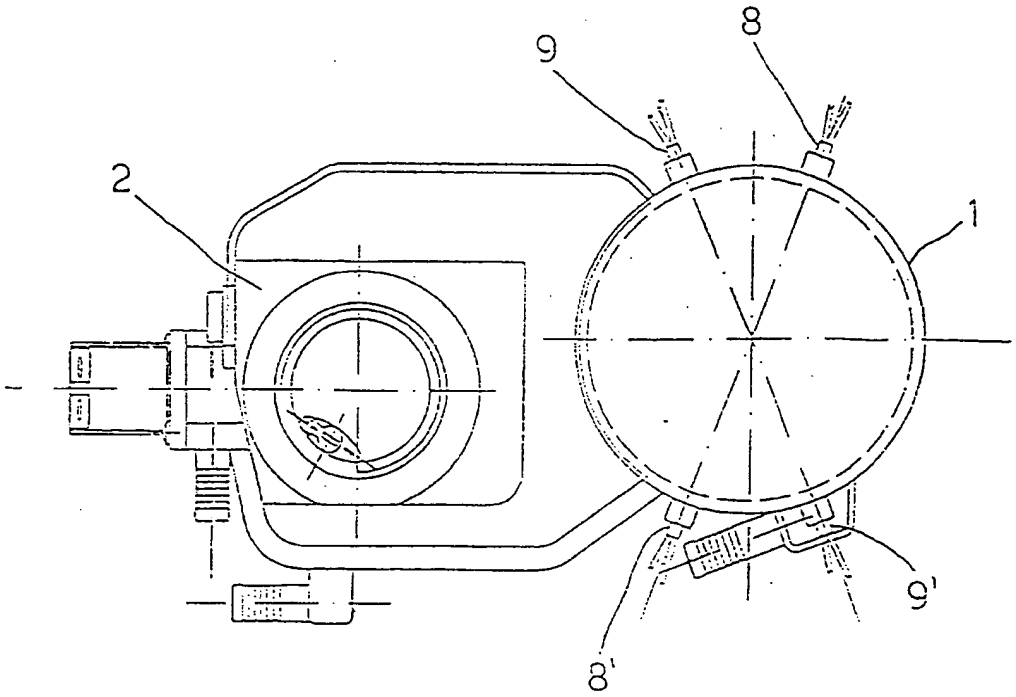

FIG. 2

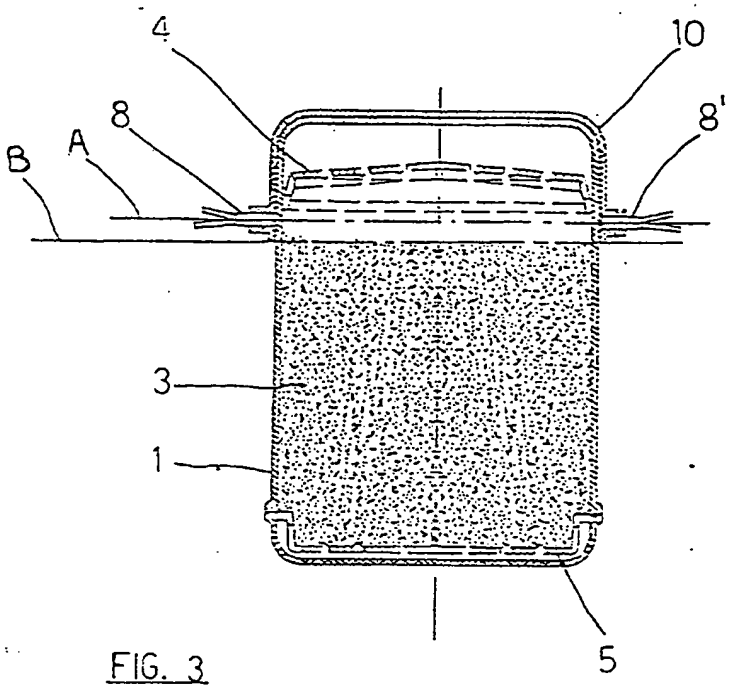

FIG. 3

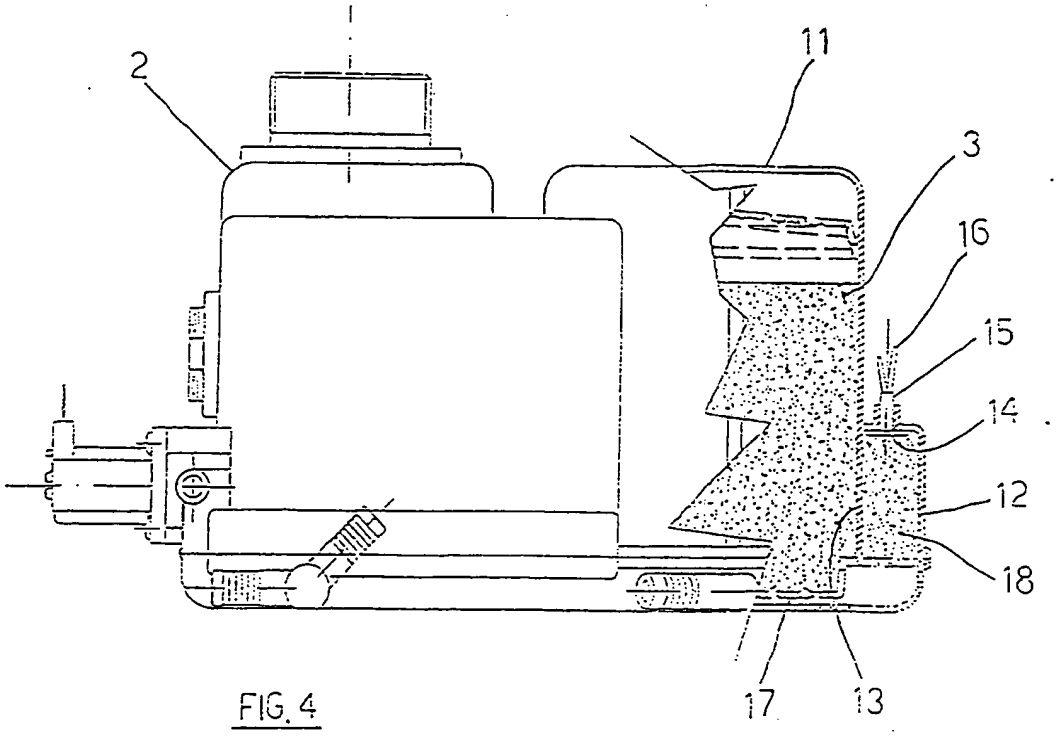

FIG. 4

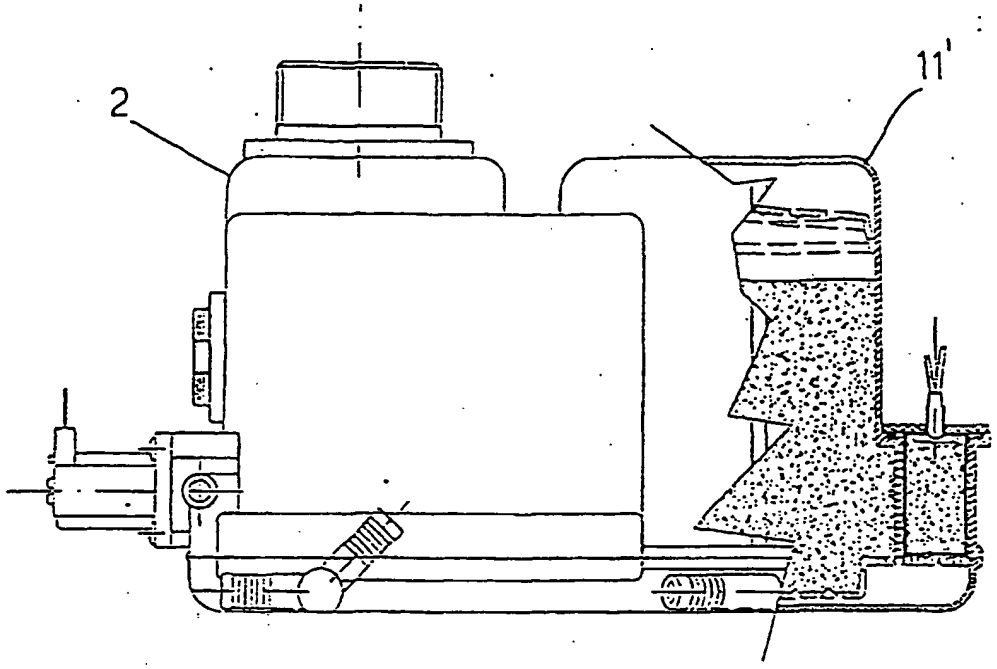

FIG. 5

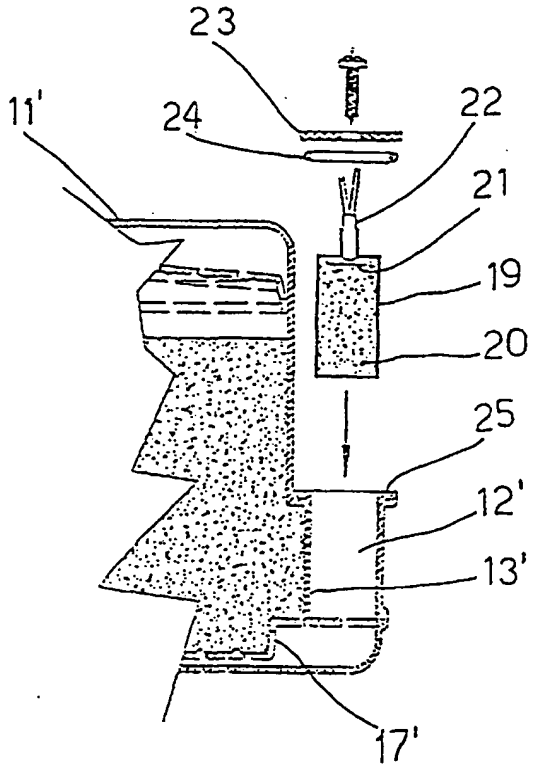

FIG. 6

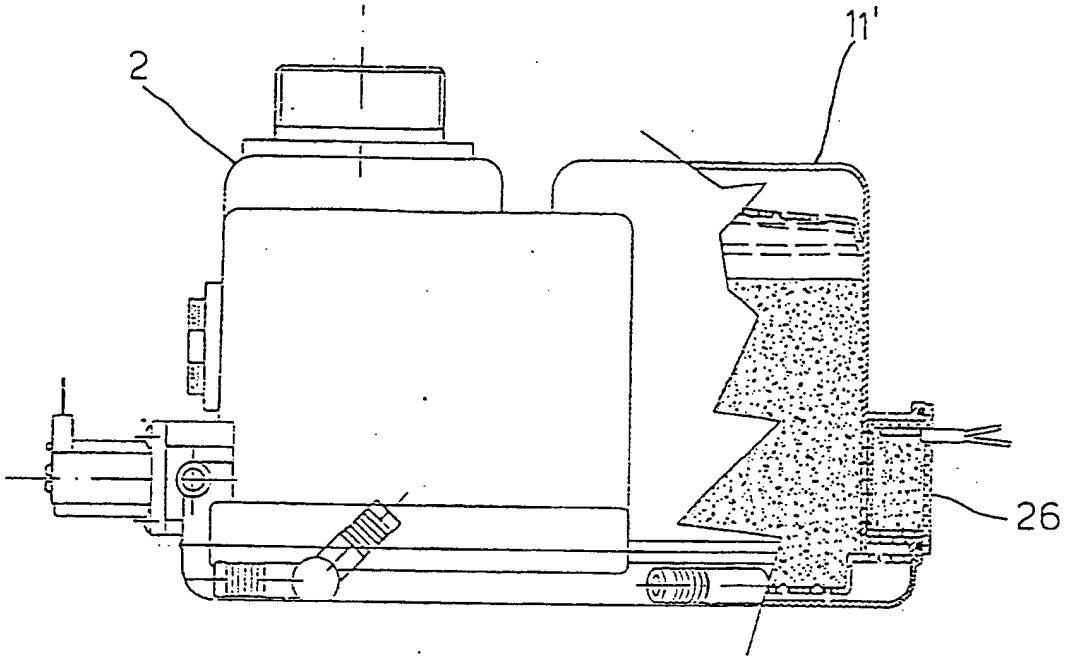

FIG. 7

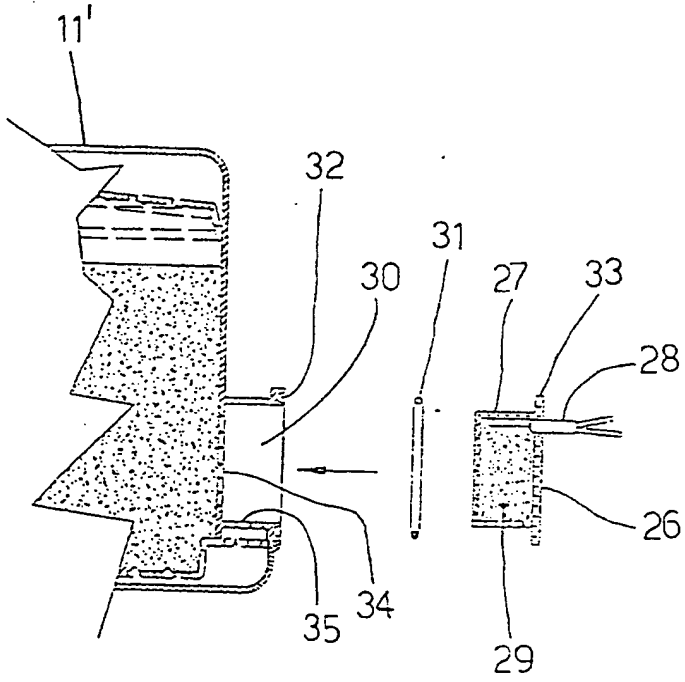

FIG. 8